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(54) Electromagnetically actuable fuel injection valve

(57) An I.C. engine fuel injection valve comprises a nozzle body (9) with a valve needle (27), which is guided therein and has a shoulder (39) upstream of which is an abutment plate (12) having an opening (20) penetrated with radial play by the valve needle (27). A passage (37) extends between the opening (20) and the circumference of the abutment plate (12), the clear width of the passage being greater than the diameter of the needle (27) in the adjacent region (38). The wall of the opening (20) is interrupted by, apart from the passage (37), further recesses (42). Sticking between the abutment plate (12) and the needle shoulder (39), as can occur through adhesion forces and residual magnetic effects, is avoided through such a construction of the abutment plate.

FIG. 1

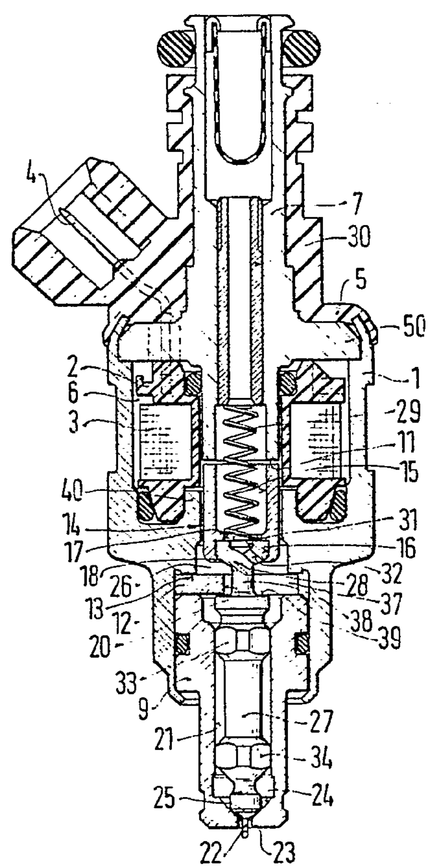

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FIG. 1

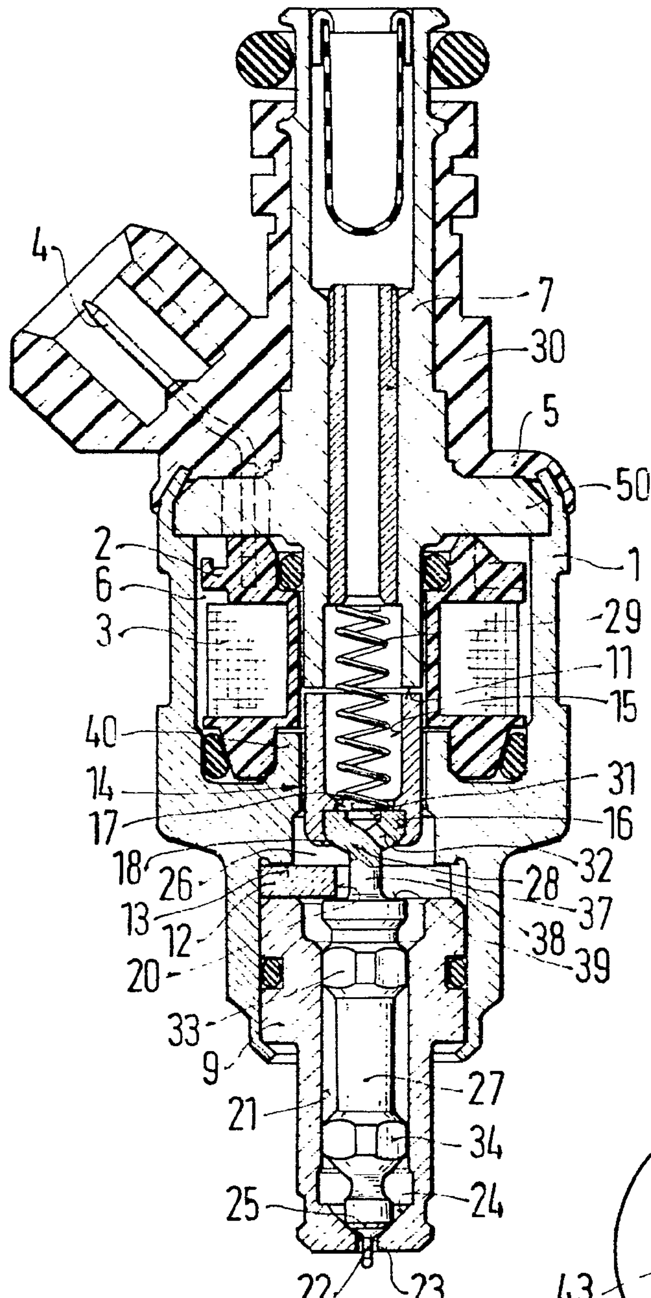
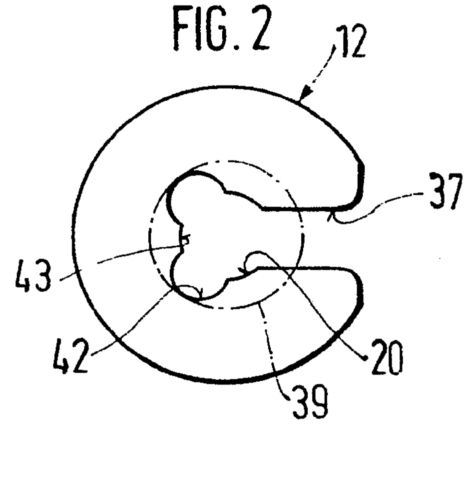


FIG. 2



SPECIFICATION

Electromagnetically actuable fuel injection valve

The present invention relates to an electromagnetically actuable fuel injection valve.

In a known fuel injection valve, the armature in the excited state of a magnet coil does not rest directly against a soft magnetic core of the valve, but an abutment shoulder, which is formed at a valve needle firmly connected with the armature, contacts an abutment fixed relative to the housing. In the valve described in DE-OS 29 05 099, this abutment is in the form of an abutment plate. Thus, a gap remains between armature and core even in the excited state of the magnet coil and magnetic sticking, as can arise due to residual magnetic effects, is thereby avoided. Nevertheless, delays during lifting of the abutment shoulder from the abutment plate can arise after the switching-off of the magnet coil due to adhesion forces acting between the abutment shoulder and abutment plate. As a result of this sticking, erroneous metering by the fuel injection valve can occur.

According to the present invention there is provided an electromagnetically actuable fuel injection valve comprising a housing, a valve seat member connected to the housing and defining a valve seat, electro-magnetic-force generating means disposed in the housing, an armature arranged to be movable by such electromagnetic force, an elongate valve body connected to the armature and guided in the member to co-operate with the valve seat, and an abutment plate arranged between the housing and the member to define an end position of the valve body by contact with a shoulder thereof and having a central bore receiving a cylindrical portion of the valve body, a passage which is wider than the diameter of that portion and extends radially from the bore to the periphery of the plate, and at least one recess provided in the wall of the bore additionally to the passage.

A fuel injection valve embodying the present invention may have the advantage that sticking between the abutment plate and shoulder is largely avoided.

An embodiment of the present invention will now be more particularly described by way of example with reference to the accompanying drawings, in which;

Figure 1 is a sectional view of a fuel injection valve embodying the invention; and

Figure 2 is a plan view, to an enlarged scale, of an abutment plate of the valve of Figure 1.

Referring now to the drawings, there is shown in Figure 1 a fuel injection valve which is for a fuel injection system of a mixture-compressing, applied ignition internal combustion engine and comprises a housing 1 of ferromagnetic material in which a magnet coil 3 is arranged on a coil carrier 2. The coil 3 has a current feed by way of a plug connection 4, which is embedded in a plastics material ring 5 partially encompassing the housing 1.

The carrier 2 of the coil 3 sits in a coil space 6 of the housing 1 on a connecting stub pipe 7, which feeds the fuel, for example petrol, and partially projects into the housing 1. The housing 1 remote from the stub pipe 7 partially encompasses a nozzle body 9.

A cylindrical armature 14 is disposed between an end face 11 of the stub pipe 7 and an abutment plate 12, which is placed on an internal shoulder 13 of the housing 1 and has a certain thickness for exact setting of the valve. The armature 14 consists of a magnetic material not susceptible to corrosion and is disposed coaxially in the housing 1 at a small radial spacing from the housing 1, thereby forming a magnetic gap. The armature 14 is provided with two coaxial blind bores 15 and 16, respectively, each extending from a respective one of its end faces, wherein the bore 16 opens out towards the body 9 and has a flat base which is provided with a coaxial bore 17 connecting the bores 15 and 16 together. The diameter of the bore 17 is smaller than that of the bore 16.

That end portion of the armature 14 which faces the nozzle body 9 is constructed as deformation region 18. This deformation region 18 has the task of mechanically connecting the armature 14 with a valve needle 27 through embracing a retaining body which is part of the valve needle 27 and fills the bore 16. The embracing of the retaining body 28 by the deformation region 18 of the armature 14 is achieved through upsetting of the region 18.

Bearing on a flat face, facing the stub pipe 7, of the retaining body 28 is a compression spring 29, which is guided through the bore 17 of the armature 14 and at the other side rests against a pipe insert 30, which is fastened in the stub pipe 7 through drawing-in of the same, the spring thus acting on the armature 14 and valve needle 27 by a force directed away from the stub pipe 7.

Let into the flat side, facing the stub pipe 7, of the retaining body 28 is a coaxial blind bore 31, which is of smaller diameter than the internal diameter of the spring 29 and at the bottom of which is disposed at least one, preferably obliquely arranged, through-flow opening 32, which produces a connection to an internal space 26 enclosed by the housing 1 and nozzle body 9. The space 26 receives the valve needle 27.

The valve needle 27 penetrates with radial play through a passage bore 20 in the abutment plate 12 and a guide bore 21 in the nozzle body 9 and has a needle spigot 22 which projects out of an injection opening 23 of the nozzle body 9. Formed between the guide bore 21 and the injection opening 23 is a conical valve seat surface 24, which co-operates with a conical sealing portion 25 of the valve needle 27. The length of the valve needle 27 and of the armature 14 is so dimensioned, starting from the sealing portion 25, that the armature 14 in the non-excited state of the coil 3 leaves a working gap free relative to the end face 11 of the stub pipe 7. When the coil 3 is excited, the thickness of this gap reduces without giving rise to direct contact of the armature 14 with stub pipe 7.

The valve needle 27 has two guide portions 33 and 34 which guide the valve needle 27 in the bore 21 and leave an axial passage free for the fuel, the guide portions being constructed with, for example, a rectangular cross-section.

In the excited state of the coil 3, the armature 14 is

moved in opening direction of the valve needle 27 against the force of the spring 29. The valve needle 27 then lies by a shoulder 39 against the flat side, facing the nozzle body 9, of the abutment plate 12.

Figure 2 shows one example of the abutment plate 12. Extending between the bore 20 and the circumference of the abutment plate 12 is a recess 37, the clear width of which is greater than the diameter of the valve needle 27 in a cylindrical region 38 of the valve needle 27 between the retaining body 28 and the shoulder 39.

The bore 20 is interrupted at its circumference by, apart from the recess 37, at least one further, peferably part-circular, recess 42. The envelope surface of the bore 20 is thereby divided into at least two segments 43 and the contact area between shoulder 39 and abutment plate 12 is reduced.

Trials with such a valve have shown that the effect of sticking between the shoulder 39 of the valve needle 27 and the flat side, resting against the nozzle body 9, of the abutment plate 12 can be appreciably reduced by the recesses 42. The optimum size of the recess 42 or of the recesses 42 may depend on different parameters, for example the diameter of the shoulder 39, the material property and surface of the valve needle 27 and abutment plate 12, the force on the valve needle 27, and the flow conditions.

The magnetic flux is conducted through the shell of the housing 1 by way of a magnetic flux conduction step 40 to the armature 14 and from there by way of the stub pipe 7 serving as core with a conducting flage 50 back to the housing 1.

CLAIMS

1. An electromagnetically actuable fuel injection valve comprising a housing, a valve seat member connected to the housing and defining a valve seat, electromagnetic-force generating means disposed in the housing, an armature arranged to be movable by such electromagnetic force, an elongate valve body connected to the armature and guided in the member to co-operate with the valve seat, and an abutment plate arranged between the housing and the member to define an end position of the valve body by contact with a shoulder thereof and having a central bore receiving a cylindrical portion of the valve body, a passage which is wider than the diameter of that portion and extends radially from the bore to the periphery of the plate, and at least one recess provided in the wall of the bore addtionally to the passage.

2. A valve as claimed in claim 1, wherein the at least one recess is part-circular in shape.

3. A valve as claimed in either claim 1 or claim 2, wherein the abutment plate has two such recesses.

4. A valve substantially as hereinbefore described with reference to the accompanying drawings.

5. A fuel injection system for an internal combustion engine, the system comprising a valve as claimed in any one of the preceding claims.

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